The Fertile Field of Meta-Analysis:
Cumulative Progress in Agricultural Forecasting

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1. Introduction

A substantial effort has been devoted to agricultural forecasting over the past half century. Allen's quantitative review provides a powerful way to examine that research. The quantitative review (or "meta-analysis" as it is commonly called since. Glass (1976) is a formal study of studies. Meta-analyses sometimes reveal conclu sions that were not obvious to those who view research findings in an impressionistic manner. Such a systematic review of the evidence should be superior to a subjective appraisal. After all, we do not trust researchers to merely look at a mass of data and decide what conclusions to draw. For those that prefer empirical evidence on the value of meta-analysis, see Cooper and Rosenthal (1980).

Allen's meta-analysis is based on sound procedures. He conducted a systematic and extensive search. Given the vast amount of research on this topic, an extensive effort was required to collect these studies and then to analyze them.

The research was summarized in an impartial manner. By providing the original sources and by showing how the papers were coded, the paper provides a firm basis for further research to build upon. Although I have no reason to doubt the accuracy of the coding, it would have been useful to ask the authors of the original research to check the codings used to represent their research in the meta-analysis. At the same time, one could ask about additional studies, published or unpublished, that might have been overlooked. Such a procedure would have added to our confidence about the conclusions of this meta-analysis.

Below, I list what seem to be the most surprising findings from Allen's meta-analysis. Then I discuss an overlooked contribution to the forecasting field. Finally, I describe an opportunity that I anticipate for this field.

2. Surprising findings

Given the amount of effort dedicated to the development of econometric methods, the evidence that they have improved forecasting in agriculture is sparse. One reason Allen offers for the lack of progress for econometric methods in agriculture is that they have not been applied where they would be most useful. For example, they have often been applied to short-range agricultural forecasts rather than to longer-range forecasts. Also, econometric forecasts have been used in situations where the causal variables, such as the weather, have themselves been difficult to forecast.

From a methodological viewpoint, Allen's most surprising conclusion is that the agricultural researchers have often failed to use proper validation procedures to test their forecasting methods. Proper validation should include the following elements:

(1) The primary criterion should be the performance on ex ante forecasts. However, ex post forecast performance can also be relevant as a way to test how well the model can forecast the impact of given policies.

(2) The proposed forecasting model should be compared against well-accepted alternative models. These should include the methods that are currently being used to make forecasts.

(3) The evaluations should be based on a sufficient sample of forecasts. Ideally, these should include different series, different starting points, and different horizons.

As shown in Collopy et al. (1994), a failure to adhere to these validation principles can lead to false conclusions about the relative value of forecasting procedures.

Overall, a basic conclusion that I reach from Allen's review is that progress in agricultural forecasting has been modest. However, success has been achieved in some areas. Perhaps the one area where progress has been most evident is in the use of intentions surveys. Intentions surveys have also improved forecasting accuracy in other fields such as politics, economics, and marketing.

3. An overlooked contribution to forecasting: bootstrapping

One of the most significant advances in the field of forecasting originated in agricultural forecasting. Wallace (1923), who later became the Secretary of Agriculture for the United States, conducted the original study using what eventually became known as bootstrapping. He showed that a statistical model could help in developing a set of rules for judging the quality of corn, a task that was then being done by experts. He was approximately half a century ahead of his time. In the mid-1970s, researchers in different fields independently rediscovered bootstrapping, and they showed that it consistently improved upon judgmental forecasting. Furthermore, bootstrapping usually produced forecasts at a much lower cost.

Progress in forecasting might have been faster had forecasting experts been aware of Wallace's work. This illustrates why the publication of Allen's meta-analysis is so important. It provides an efficient way to summarize the major findings in a field. This will increase the likelihood that the important findings will be noticed by other researchers.

4. An overlooked opportunity: role-playing

Governments have traditionally had an important impact on agriculture with their quotas, price supports, and subsidies. One might expect that an ability to forecast governmental agricultural policies would be of significant value. But despite the practical importance of this topic. Allen's meta-analysis uncovered no work in this area.

Role-playing techniques have been shown to improve forecasting of the decisions made in conflict situations (Armstrong 1987). Successful applications of role-playing have been made in politics, marketing, and the law. It would seem useful to compare this procedure with unaided expert opinions in forecasting the agricultural decisions by government agencies.

5. Conclusions

A good review should tell us what we know, how we learned it, and what we do not know. The conclusions should follow clearly from the empirical studies. Allen's review accomplishes these goals. For example, little is known about how to forecast major determinants of agricultural production, such as political decisions. What we know is modest in light of the effort. One of the major reasons for the modest progress is that the validation procedures have been deficient.

6. References

Armstrong, J.S. (1987), "Forecasting methods for conflict situations," in G. Wright and P. Ayton, eds., *Judgmental Forecasting.* John Wiley: Chichester, pp. 157-176.

Collopy, F., J.S. Armstrong and M. Adya (1994), "Principles for, examining predictive validity: The case of information systems spending forecasts," *Information Systems Research*. 5, 170-179.

Cooper, H. and R. Rosenthal (1980), "Statistical versus traditional procedures for summarizing research findings," *Psychological Bulletin,* 87, 442-449.

Glass, G. (1976), "Primary, secondary, and meta-analysis of research," *Educational Researcher,* 5 (9), 3-8.

Wallace, H.A. (1923), "What is in the corn judge's mind?" *Journal of the American Society of Agronomy, 15,* 300-304.